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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/180,629	11/12/1999	Aaron Fenster	1814.31	7008

5514 7590 09/20/2002

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EXAMINER

SUKHAPHADHANA, CHRISTOPHER T

ART UNIT	PAPER NUMBER
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2623

DATE MAILED: 09/20/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/180,629

Applicant(s)

FENSTER ET AL.

Examiner

Christopher T. Sukhaphadhana

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— The MAILING DATE of this communication appears on the cover sheet with the correspondence address —

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-13 is/are pending in the application.
- 4a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 1-13 is/are rejected.
- 7) ☒ Claim(s) 6 is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 12 November 1999 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on ____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. ____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). ____
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 2. 6) ☐ Other:

DETAILED ACTION

Drawings

1. Figures 1, 2A, and 2B should be designated by a legend such as --Prior Art-- because only that which is old is illustrated. See MPEP § 608.02(g). A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.
2. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they do not include the following reference sign(s) mentioned in the description:

“System 20” on page 5, line 12, et al.

“Transducer scanning control module 98” on page 8, line 4.

A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

3. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they include the following reference sign(s) not mentioned in the description:

Probe Scanning Control Module (96) in Fig. 4.

A proposed drawing correction, corrected drawings, or amendment to the specification to add the reference sign(s) in the description, are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

Specification

4. The disclosure is objected to because of the following informalities:

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the expression “reconstructed” on page 11, line 13, should perhaps be changed to “reconstruction” to better fit the context of the sentence;

the expression “preffered” on page 11, line 29, should perhaps be changed to “preferred”;

the expression “top right-hand corner” on page 12, line 17, should be changed to “top left-hand corner” to properly correspond to the figure mentioned;

the expression “or” on page 12, line 29, should perhaps be changed to “of” to better fit the context of the sentence;

the expression “acquitition” on page 13, line 1, should perhaps be changed to “acquisition”;

the expression “three-dimensioanl” on page 13, line 30, should perhaps be changed to “three-dimensional”;

the expression “form” on page 13, line 30, should perhaps be changed to “from” to better fit the context of the sentence.

Appropriate correction is required.

Claim Objections

5. Claim 6 is objected to because of the following informalities: The claim does not end in a period. Appropriate correction is required.

Claim Rejections - 35 USC § 112

6. The following is a quotation of the first paragraph of 35 U.S.C. 112:

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The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

7. Claim 12 is rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

Claim 12 claims "the reverse map encloses edges of each two-dimensional image" on line 1. The specification discloses that plane P1 in Fig. 9A and 9B is an isomorphic data plane wherein a reverse map grid lies (page 12, lines 11-15 and 30-31). However, as shown in Fig. 9A and 9B, plane P1 does not enclose any edges of images S1, S2, or S3.

8. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

9. Claims 4, 9, 10, and 13 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

10. Claim 4 recites the limitation "the transducer" in line 6. There is insufficient antecedent basis for this limitation in the claim.

Claim 9 and 10 are dependent on claim 4 and inherit the wordage of claim 4.

11. Claim 13 recites the limitation "the calibration file" in the sixth paragraph. There is insufficient antecedent basis for this limitation in the claim.

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It appears that the limitation for claim 13 should read as "the data set" and, for the application of prior, the claim will be treated as being worded as such.

Claim Rejections - 35 USC § 102

12. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

13. Claims 1, 3, and 13 are rejected under 35 U.S.C. 102(b) as being anticipated by Quistgaard (U.S. Patent 5,485,842).

In regards to the three-dimensional imaging system in claim 1 of the present invention, Quistgaard discloses a three-dimensional imaging system comprising:

a scanning means (10) to: scan the target volume using an angular scanning technique (col 4, line 5), and generate a succession of two-dimensional images representing cross-sections of the target volume on a plurality of planes spaced around an axis of rotation of the scanning means (col 4, line 15);

a memory means (34) storing the succession of digitized two-dimensional images (1', 2', 3' in Fig. 5a-d) and a data set comprising parameters defining the geometric (col 4, lines 59-63) and orientational (col 7, lines 60-63) relationship between successive digitized images; and

a transformational means for: receiving the digitized two-dimensional images and the data set (32), and transforming the digitized two-dimensional images directly into a three-dimensional image (col 9, lines 15-46).

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In regards to the method of transforming a succession of two-dimensional images in claim 13, a similar argument can be made.

In regards to claim 3, Quistgaard further discloses the angular scanning technique as a fan scanning technique (col 4, line 5).

Claim Rejections - 35 USC § 103

14. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

15. Claims 2 and 5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Quistgaard as applied to claim 1 above, and further in view of Fenster et al (U.S. Patent 5,454,371).

In regards to claim 2, Quistgaard does not specifically disclose the angular scanning technique as an axial scanning technique.

Fenster '371 teaches the use of an axial scanning technique (Fig. 4) for use in a three-dimensional imaging system similar to Quistgaard.

The ultrasonic probe (10) of Quistgaard undergoes the motion of Fenster's probe (24) indicated by arrow 48 to achieve the desired scanning technique. One skilled in the art would utilize this scanning technique for scanning organs of a subject under examination, such as the eye or prostate (Fenster '371, col 5, lines 35-38).

In regards to claim 5, Quistgaard does not specifically disclose storing data defining the degree of out-of-plane tilt of the transducer, the degree of out-of-plane displacement, nor the degree of in-plane tilt.

Fenster '371 teaches of using said data (col 8, lines 24-52) to compensate for inaccuracies in the final reconstructed three-dimensional image (col 8, lines 63-65). Once said data were known, it would be obvious to one skilled in the art to store said data because they are constant for any set of image lines of an image array to be reconstructed (col 10, lines 23-38) and can be reused for such reconstruction without unnecessary recalculation.

16. Claim 4, 9, and 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Quistgaard as applied to claim 1 above, and further in view of Fenster et al (U.S. Patent 5,842,473) and Hossack et al (U.S. Patent 6,360,027).

In regards to claim 4, Quistgaard additionally discloses the storage of the total angle of acquisition (col 6, lines 35-54). Quistgaard anticipates the storage of a 90deg sector image (col 6, line 40). This storage of this value is necessary to estimate the amount of physical space the image represents as shown in Figure 3, and this value can be used to keep track of virtual viewpoint changes as shown in col 5, lines 20-43.

Quistgaard further discloses the storage of the total number of acquired images (col 4, lines 19-23). Quistgaard anticipates the typical storage of 100 to 200 images (col 6, line 20). A data structure used to store images commonly employed and known to one skilled in the art is an image data array, as evidenced in Hossack et al, ref 18. A property inherent to an array data

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structure is the index of each element of the array, typically used for selective access to a desired element, as well as the bounds of the numeric value of the index usually described by one skilled in the art as the “length” of the array. The length of the array is stored in memory and used to ensure that access to the images do not extend beyond the number of images stored in memory, and this length value represents the total number of two-dimensional images taken. One skilled in the art would use an image data array as the method of data storage because it provides quick access to any given image.

Quistgaard does not disclose the remaining limitations set forth in claim 4.

Fenster '473 teaches the storage of an address pointer of the location of the images (col 2, line 24), the horizontal and vertical voxel sizes (col 2, lines 27-32), and the width and height of each acquired image (col 2, line 26).

Hossack et al teaches the storage of the location of the axis of rotation with respect to each of the images (col 8, lines 3-6), the relative location of each acquired image to the transducer (col 5, lines 6-11), and the angular separation of each image (col 13, lines 3-8 and col 16, lines 20-23).

One of reasonable skill would know that the information taught by Fenster '473 and Hossack as described can be stored in a header file to each image, a practice well known in the art. Fenster '473 teaches that this information can be used to allow a display module to interpret the acquired image data correctly (col 6, lines 19-23), and Hossack et al teaches that this information can be used in registering the respective image data frames appropriately in three-dimensions to form the desired three-dimensional representation (col 2, line 66).

In regards to claim 9, Fenster '473 further discloses the width and height of each acquired image as the number of pixels along the x and y axis of each two-dimensional image (col 2, line 26).

It would be obvious to one skilled in the art to store the total number of two-dimensional images taken as the total number of acquired images because the total number of two-dimensional images taken is the maximal number of two-dimensional images the system would need access from the image data array. Quistgaard's system stores planar (two-dimensional) images (col 4, lines 20-21).

In regards to claim 10, Fenster '473 further discloses the horizontal and vertical voxel sizes as the physical distance between adjacent pixels (col 2, lines 28-30).

17. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Quistgaard as applied to claim 1 above, and further in view of Fenster et al (U.S. Patent 5,842,473), and Hossack et al (U.S. Patent 6,360,027).

Quistgaard does not teach the storage of the parameters as comprised in claims 6 and 7.

Fenster '473 teaches calibrating for the horizontal and vertical voxel sizes in col 6, lines 44-52.

Hossack et al teaches storing the location of the axis of rotation with respect to each of the images (col 8, lines 3-6).

One of ordinary skill in the art would store this calibration information because it is used to interpret the image data correctly (Fenster '473, col 6, line 19-23).

18. Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Quistgaard, Fenster '473, and Hossack et al as applied to claim 6 above, and further in view of Fenster et al (U.S. Patent 5,454,371).

Quistgaard, Fenster '473, and Hossack do not specifically disclose storing calibration data comprising the degree of out-of-plane tilt of the transducer, the degree of out-of-plane displacement, nor the degree of in-plane tilt.

Fenster '371 teaches of using said calibration data (col 8, lines 24-52) to compensate for inaccuracies in the final reconstructed three-dimensional image (col 8, lines 63-65). Once said data were known, it would be obvious to one skilled in the art to store said data as calibration data because they are constant for any set of image lines of an image array to be reconstructed (col 10, lines 23-38) and can be reused for such reconstruction without unnecessary recalculation.

19. Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Quistgaard as applied to claim 1 above, and further in view of Fenster et al (U.S. Patent 5,842,473), and Hossack et al (U.S. Patent 6,360,027).

Quistgaard additionally discloses the storage of the total angle of acquisition (col 6, lines 35-54). Quistgaard anticipates the storage of a 90deg sector image (col 6, line 40). This storage of this value is necessary to estimate the amount of physical space the image represents as shown in Figure 3, and this value can be used to keep track of virtual viewpoint changes as shown in col 5, lines 20-43.

Quistgaard further discloses the storage of the total number of acquired images (col 4, lines 19-23). Quistgaard anticipates the typical storage of 100 to 200 images (col 6, line 20). A data structure used to store images commonly employed and known to one skilled in the art is an image data array, as evidenced in Hossack et al, ref 18. A property inherent to an array data structure is the index of each element of the array, typically used for selective access to a desired element, as well as the bounds of the numeric value of the index usually described by one skilled in the art as the "length" of the array. The length of the array is stored in memory and used to ensure that access to the images do not extend beyond the number of images stored in memory, and this length value represents the total number of acquired images. One skilled in the art would use an image data array as the method of data storage because it provides quick access to any given image.

Fenster '473 teaches the storage of the width and height of each acquired image (col 2, lines 23-32).

Hossack et al teaches the storage of the relative location of each acquired image to the transducer (col 5, lines 6-11) and the angular separation of each image (col 13, lines 3-8 and col 16, lines 20-23).

One of reasonable skill would know that the information taught by Fenster '473 and Hossack as described can be stored in a header file or an associated information file to each image upon the acquisition of said image, a practice well known in the art. Fenster '473 teaches that this information can be used to allow a display module to interpret the acquired image data correctly (col 6, lines 19-23), and Hossack et al teaches that this information can be used in

registering the respective image data frames appropriately in three-dimensions to form the desired three-dimensional representation (col 2, line 66).

20. Claims 11 and 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Quistgaard as applied to claim 1 above, and further in view of Yamazaki et al (U.S. Patent 5,497,776).

In regards to claim 11, Quistgaard does not expressly disclose a means to generate a reverse map.

The specification defines a reverse map as a look-up table or partial look-up table used to determine the location within the succession of two-dimensional image slices of the particular pixels which must be retrieved from memory to produce the display image selected by the user (p 11, line 30).

Yamazaki et al teaches the display of side planes (col 11, line 18) where the side planes displayed are determined by the position of cross section lines set by the user (col 11, line 1). The reference reads on the claim because in each case, a method of selecting pixels from the stored images relies on an input (look-up table or cross section lines) to determine which pixels should be selected for display. In other words, the cross section lines determine which pixels to be displayed from the stored images in the same manner the look-up table determines which pixels to display for the present invention. Thus, the reference performs the same function as the claim.

One of ordinary skill in the art would combine the transformation means of Yamazaki et al with the system of Quistgaard because Quistgaard's system displays only the three-

dimensional image while Yamazaki's transformation means can display the three-dimensional image and a base plane on one screen (Fig 5a).

In regards to claim 12, Quistgaard does not expressly disclose the reverse map enclosing edges of the images nor an orientation in a plane orthogonal to the planes of the images.

Yamazaki further teaches his transformation means incorporates the edges of the acquired images (Fig 4) and displaying an orientation orthogonal to the planes of the images (Fig 4 and col 11, line 19).

Conclusion

21. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

22. Evert (U.S. Patent 4,377,088), Pini (U.S. Patent 5,159,931), Okunuki (U.S. Patent 5,460,179), Seyed-Bolorforosh (U.S. Patent 5,460,181), and Seward et al (U.S. Patent 5,699,805) teach ultrasonic transducers for use in three-dimensional ultrasound imaging and methods of image reconstruction for the obtained images.

23. Furuhashi (U.S. Patent 5,078,145), Ito et al (U.S. Patent 5,353,220), Kazi et al (U.S. Patent 5,377,685), Weng (U.S. Patent 5,396,890), Fujita et al (U.S. Patent 5,413,106), Sliwa, Jr. et al (U.S. Patent 5,465,724), Schwartz et al (U.S. Patent 5,474,073), Olstad et al (U.S. Patent 5,476,096), and Friemel et al (U.S. Patent 5,899,861) teach three-dimensional ultrasound imaging systems utilizing either an axial or fan scanning technique and associated methods of image reconstruction.

24. Wollschlager et al (U.S. Patent 5,295,486) teaches an ultrasound device storing the relative orientation of each image to the transducer.
25. Edwards et al (U.S. Patent 5,787,889) teaches an ultrasound imaging system storing the voxel sizes and angular separation of the images.
26. Dekel et al (U.S. Patent 5,810,008) teaches an apparatus for visualizing ultrasound images which stores the axis of rotation of the transducer and the relative orientation of each image to the transducer.
27. Polz (U.S. Patent 5,924,989) teaches a method of ultrasound image capture which stores the voxel sizes and the angular separation of each image.
28. Fenster et al ("3-D Ultrasound Imaging: A Review", IEEE) teaches axial and fan scanning techniques and associated image reconstruction techniques.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Christopher T. Sukhaphadhana whose telephone number is 703-306-4148. The examiner can normally be reached on 8a-4p M-F.


If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amelia Au can be reached on 703-308-6604. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9314 for regular communications and 703-872-9314 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-306-0377.

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